# Urban-rural differences in physical performance and health status among older Japanese community-dwelling women



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**ORIGINAL ARTICLE**

# URBAN-RURAL DIFFERENCES IN PHYSICAL PERFORMANCE AND HEALTH STATUS AMONG OLDER JAPANESE COMMUNITY-DWELLING WOMEN

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## ABSTRACT

**Background/Purpose:** Assessment of physical performance allows the identification of health and functional independence among older adults. Several factors, such as environmental conditions, influence the results; therefore our objective was to compare the physical performance and the health status between older Japanese women living in urban and rural communities.

**Methods:** Subjects were Japanese women aged ≥65 years, recruited in urban (n=41, age=73.8 ± 3.92) and rural (n=54, age=73.8 ± 4.15) locations through a local press. Physical performance was assessed by the Timed Up and Go (TUG), one leg stand (OLS), repeated chair stands (CS) and handgrip strength (HGS) tests. Health status was investigated using socio-demographic characteristics; anthropometric measures and body composition; physical activity, a pedometer, Life-Space Assessment (LSA); Geriatric Depression Scale; incidence of falls, fear of falling; and medical information. Variables were compared by $\chi^2$ test, Independent-Samples T-test and Mann Whitney U-test.

**Results:** Rural subjects presented better performance in HGS (p=0.01) than urban subjects, who had better performance in CS (p<0.001). No statistical differences were found in TUG or OLS. Rural subjects also had higher body mass index (p=0.04), waist circumference (p<0.01), body fat percentage (p=0.014) than urban subjects, who showed higher scores in LSA (p<0.001). Concerning medical information, more rural subjects complained of low back pain (p=0.01) and gastrointestinal problems (p=0.02).

**Conclusion:** Our findings showed that the physical performance and health status varied according to the place. Rural subjects had worse results in CS, but better performance in HGS than urban subjects. We emphasize that health interventions should address the specific demand of each location.

**Keywords:** Physical activity; health status; rural health; urban health; older women.

## INTRODUCTION

Japan has the world's highest average life expectancy, reaching 86.4 years for women, according to the 2010 records.[1] However, specialists have defended that the process of aging "well", such as remaining healthy, vigorous, and free of disability is as important as the absolute number of years achieved.[2]

One of the enemies to the process of aging well is a sedentary lifestyle; a key risk of premature morbidity and mortality. Following this concept, the assessment of physical performance is receiving special attention, because it allows an early identification of older adults at risk of health and functional decline, situations that typically precede the onset of disability.[3,4] Moreover, physical performance measures are predictors of functional, psychological, and social health;[4,5] and additionally, in this complex relationship, they are influenced by several factors, such as environmental conditions.

Studies have shown that physical activity levels differ according to the environment; in rural communities, the physical activity level could be expected to be lower than that in urban neighborhoods.[6,7] A study conducted in Japan examined the association between the neighborhood environment and physical activity among Japanese adults;[8] however, to our knowledge, no study has directly compared the physical performance and the health status between older urban and rural community-dwelling adults yet. Therefore, we aimed to compare the physical performance and the health status between older Japanese women living in urban and rural communities.

# METHODS

## Study Subjects

The subjects were older Japanese women, recruited in urban (n=41) and rural (n=54) locations through the local press by requesting healthy community-dwelling volunteers to collaborate in this research. The inclusion criteria were an age of 65 years or older and the ability to perform the physical tests, to fill the questionnaires, and to give consent to participation in the study. Data was collected from November 2011 to March 2012.

Rural and urban locations were defined and classified directly with emphasis on the morphology of their settlements and the wider geographic context of such settlements. This approach ensured that the focus remained clearly on the most physical aspects of these environments as described elsewhere.[9] The participants in urban location lived in Kyoto city (1.47 million people), while the population in rural environments was less than 9000 in an area of 15.2 $km^2$. For this categorization, we also considered factors beyond the population size, such as differentiation by economic field, in which rural residents used the land as a direct source of income or wealth generation.

## Physical performance

In the Timed Up and Go (TUG) test, subjects were asked to stand up from a standard chair, walk 3 meters distance, turn, and sit down again; short measured time indicated better ability. In the one leg stand (OLS) test, subjects were instructed to stand unassisted on one leg, eyes opened and arms by the side of the trunk; the OLS was timed not exceeding 30 seconds, with a longer time indicating better balance ability. In the repeated chair stands (CS), participants were asked to stand up and sit down five times from a chair as quickly as possible keeping arms folded across the chest. Finally, handgrip strength (HGS) was tested with a standard handheld dynamometer (HHD; mTas F-1; ANIMA, Tokyo, Japan); the participant was asked to stand up and hold the dynamometer with arms parallel to the body, the handgrip strength was measured for both hands once on each side, and a higher value was used to characterize the maximum muscle strength of the subject, as previously described.[10] Handgrip strength was expressed in kilograms (kg).

Health status

Socio-demographic characteristics, such as age, living structure, educational level and current work; anthropometric measures, such as body mass index (BMI), waist circumference (WC); and body composition features, body fat percentage (BF%), skeletal muscle mass index (SMMI), arm muscle mass, and leg muscle mass – collected by bioelectrical impedance analysis (Inbody 430; Biospace Co, Ltd, Seoul, Korea) – were obtained.

Regarding the bioelectrical impedance, the instrument makes use of eight tactile electrodes: two are in contact with the palm and thumb of each hand and two with the anterior and posterior aspects of the sole of each foot. The subject stands with their soles in contact with the foot electrodes and grabs the hand electrodes. Resistance of arms, trunk, and legs was measured at frequencies of 5, 50 and 250 kHz. Examination provided values for skeletal muscle mass, BF% and segmental muscle mass (right and left arms and legs, and trunk). From these measurements, skeletal muscle mass was then adjusted by height and for segmental muscle mass. This bioelectrical impedance method had previously been validated as having a strong correlation to muscle volume and fat mass as measured by dual energy X-ray absorptiometry.[11]

Moreover, regular practice of PA was collected by a self-administered questionnaire and was characterized by moderate walking, gymnastics, resistance training, yoga, golf, and other activities; answers are described in Table 3. Then, pedometer data (Yamax Powerwalker EX-510; Yamasa Co, Ltd, Tokyo, Japan), and Life-Space Assessment (LSA)[12] were also collected. Concerning pedometer, subjects were recommended to wear the instrument in the morning and to register the number of steps in a diary at the final of the day. After one week they were requested to send the pedometers by mail to researchers, including the diary record. The diary record was then matched with pedometer memory and an average of steps counting in one week was used in analysis.

For psychological characteristics, Geriatric Depression Scale (GDS-15) was measured. And finally, the information about incidence of falls in one year period, fear of falling; medical information, such as medical consultation frequency and hospitalization history in the last 6 months, medications, and comorbidities were also collected. Through a self-administered questionnaire, subjects were asked about the presence or absence of low back pain, diabetes, osteoporosis, hypertension, hyperlipidemia, arthropathy and gastrointestinal problems; their report was considered positive when they assumed to use prescribed medication for the specific comorbidity.

The study protocol was approved by the Kyoto University Graduate School of Medicine Ethics Committee (No. E1245, 2011). All participants were informed of the purpose and procedures of the study and a written consent was obtained.

Statistical analysis

Aiming to verify the normality of data, the Shapiro-Wilk test was used. Subjects' characteristics were investigated using descriptive analysis. Socio-demographic and categorical health-status variables were compared by living environment using $\chi^2$ test, while continuous variables were analyzed by Independent-Samples T-test, if normally distributed, or Mann Whitney U-test, if skewed. Concerning the functional performance tests, only the CS was analyzed by Independent-Samples T-test, while for the others was used Mann Whitney U-test. The considered level of significance was $p<0.05$. For data analysis was used the Statistical Package for the Social Science (SPSS), version 15.0.

## RESULTS

In total, 95 older women (urban n=41, age 73.7 ± 3.92; rural n=54, age 73.7 ± 4.15) participated in this study. Socio-demographic characteristics are shown in Table 1. Despite no statistical differences in their characteristics, an environmental difference was observed. Those in rural areas lived in groups of three persons or more (52.8%), while those in urban environments had the same proportion in all categories of living alone, with a spouse, or three persons or more (33%). Moreover, rural subjects showed slightly lower educational level, in which most of them studied until junior high school (40%), while urban ones studied until high school (34.3%) or university (20%). Additionally, rural subjects did not work (45.1%) or were engaged in farm work (37.3%), and the majority of urban subjects were retired (67.5%).

As shown in Table 2, participants living in rural neighborhoods presented better performance in HGS (p=0.01) than urban subjects. In contrast, urban ones had better performance in CS (p<0.001). No statistical differences were found in TUG or OLS.

According to anthropometric measures, rural subjects had higher BMI (p=0.04), WC (<0.01) and BF% (p=0.01) than urban subjects. A tendency in more engagement in physical activity (p=0.05) and higher scores in LSA (p<0.001) was found in urban participants, even though a statistically insignificant higher average pedometer count was found in rural subjects.

The median found in GDS was low (urban=1 vs. rural=2); most of the urban subjects had 7 or more medical consultations (30%) in the last 6 months, while rural subjects had 5 or 6 times (24.5%); 7.5% of urban vs. 5.6% of rural subjects were hospitalized in the last 6 months; and 80% of urban and 81.5% of rural subjects took medications. Concerning the above mentioned factors, no statistical differences were found between the 2 groups; however more rural subjects complained of low back pain (rural 27.8% vs. urban 7.3%, $p=0.01$) and gastrointestinal problems (rural 16.7% vs. urban 2.4%, $p=0.02$) (Table 3).

## DISCUSSION

The main findings of our study were that the physical performance and health status differed according to the environment; the subjects from rural areas had better performance in HGS and worse in CS. Additionally, rural subjects presented higher BMI, WC, BF%, higher prevalence of low back pain, and gastrointestinal problems, and higher weekly average step counts than urban participants. On the other hand, those living in urban areas showed higher regular physical activity engagement and higher scores in LSA.

Even though no statistical difference was found, rural subjects had slightly higher arm muscle mass and urban individuals higher leg muscle mass. One possible explanation for this difference is regarding their lifestyle routine (e.g. rural subjects were more involved in farm work, that usually requires hand and general strength, while urban subjects seems to be more engaged in physical activity and had higher scores in LSA). However, this is only a hypothesis as lifestyle factors were not investigated in detail.

Concerning the CS, rising from a chair is a complex task involving movement of all body segments from head to foot; the activity requires coordinated joint mobility, strength and balance to enable the center of mass to be transferred forward and upward from the seated position to erect standing.[13] One could say that the lower performance on CS in rural participants may be linked with the higher incidence of low back pain, as this comorbidity was identified by Janssen et al (2002) as a subject-related determinant for CS in a review study. Additionally, in our research the CS was done with arms folded across the chest; studies have verified that standing without using armrests requires different kinematics and kinetics, and older adults usually do trunk flexion to keep the balance. Beginning the movement from a position different from erect is also related with increased time movement[14] and could be influenced by low back pain as well. In our studied rural sample, the farm work might be a possible cause for this comorbidity[15] as it frequently requires a kyphotic or squatting position in agriculture.

Moreover, the class of medications usually prescribed for low back pain includes nonsteirodal anti-inflammatory drugs, skeletal muscle relaxants, opioid analgesics in its majority; unfortunately we did not investigate the classes of the medication that subjects used, however there is evidence supporting that some of this class of medications may be related with their gastrointestinal problems as well.[16]

The values that we found for HGS and CS in urban individuals were similar to previous studies developed in urban communities in Japan;[10,17] however our studied rural group had higher HGS and lower CS compared with them.

A study aimed to identify HGS cutoffs for women and its results showed the threshold of 21 kg at any level of BMI, with values below the cutoff indicating mobility limitations.[18] Another study verified that poor HGS is a predictor of accelerated dependency in activities of daily living (ADL) and cognitive decline in oldest old[5] and predicts cause-specific mortality in middle-aged and elderly individuals.[19]

Additionally, subjects from rural environments had higher BMI, WC and BF% than the subjects from urban cohort, however both groups are inside the cutoff values for BMI according to the World Health Organization (normal range from 18.5 to 24.99 $kg/m^2$) [20] and specific WC (80 cm) for the diagnosis of metabolic syndrome in Japanese women.[21] Such differences on anthropometric features are also linked with lifestyle factors, however as we did not investigate dietary habits, we cannot extend our conclusions to this point.

TUG has been used as a screening of fall risk.[22] The values we found were better in comparison with other studies; Herman et al (2011) verified a mean score of 9.5 ± 1.7s, ranging from 5.4 to 15.6s, however their study involved both genders. Another study developed in Japan only with women (mean age 78.6 years) found for TUG the mean score of 10.3s,[23] and a review study referenced an Australian research that found a mean of 8.5 ± 1.6 s for women aged 70-79 years.[24]

Another review study conducted by Michikawa et al (2009) identified reference values for OLS time in elderly subjects, and stated that this measure of balance can be used as a practical marker to screen the elderly for frailty. Because various procedures are used the measured values varied widely from study to study, with the mean reported of women aged 70-79 years ranging from 6.9 to 32.9 (considering the maximum time of 60s). Clearly, this variation may be due to individual as well as procedural differences. And more, many studies provided combined data for men and women. In their original research, the authors found the median value of 27.8 for women aged 75-79 years, also considering the maximum time of 60s execution.[25] Despite the different methodology, our results are similar to theirs.

In our study, rural subjects showed lower scores in LSA and a tendency to be less engaged in physical activity. Our results were consistent with another urban-rural comparison study conducted in the United States showing that rural older women had higher BMI and less engagement in physical activity than urban counterparts.[7] Consistently, another study showed that rural subjects had less engagement in physical activity and less active transportation.[6] In Japan, a study was conducted to examine the association between the neighborhood environment and physical activity among Japanese adults; they reported that people living in neighborhoods with high residential density, good access to shops, presence of sidewalks, and presence of bike lanes had higher physical activity levels.[8] Furthermore, Peel et al (2005), in a study about the measure of mobility for older community-dwelling adults, found that rural subjects also had lower physical performance and function, but higher scores in LSA than urban subjects. The authors justified their findings stating that rural subjects usually travel farther to accomplish tasks, and some community services enabling residents to stay at home, may be unavailable in rural communities.[26]

The study conducted by Van Dyck et al (2010) showed additional evidence regarding pedometer data, in which they concluded that rural subjects had less average steps per day than urban ones, contrasting with our results that showed a higher weekly average steps in subjects from rural environment; however their sample was younger (mean age=42.4) than ours.[6] A National survey conducted in Japan showed 5823 steps per day on average in people aged 65-74 years, similar to our findings from urban community, but lower than the rural community observed.[27] We may explain our results by the socio-demographic data that subjects from rural community were more engaged in work and farm activities even though no statistical differences were found. Performing these daily activities is expected that they show more steps per day. Additionally, we may reinforce the result of LSA supposing that if the subjects from rural communities had lower scores, seems that they do not travel farther and use less transportation than urban ones. Aiming to move into the community or going to work they may do it by foot and consequently they had more steps per day/week. Moreover, they may walk to nearby fields for agriculture work.

LSA is an important measure of frailty as it allows early verification of mobility restriction, which may permit the identification of persons in the course of disability development and at a time when such disability can be prevented. This approach in community dwelling older adults showed strong correlations with age,[28] physical performance measures,[12] daily activities,[12,28] comorbid conditions,[12,28] depressive symptoms,[12] social activities,[28] self-reported health,[12,28] and poor psychological well-being.[28]

Our findings should be useful in targeting and evaluating interventions that enable people to maintain independent mobility and physical performance in their living environment. And then, we emphasize that health interventions should address the specific demand of each location.

To our knowledge, no study has been done to show direct comparison regarding physical performance and general health status in older urban and rural Japanese women, and our study is the first that shows some evidence about these variables. However, it has several limitations such as the small sample size, a different number of respondents in each assessment, and it comprehends only one gender. Therefore, further studies with variability of geographic settings and a larger sample are needed to continue the investigation concerning the environment differences and to confirm our findings.

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**DISCLOSURE STATEMENT**

None of the authors have conflict of interest or financial disclosures.

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Table 1. Socio-demographic characteristics of older women living in urban and rural communities

| Variable | Urban | N | Rural | N | p |
|---|---|---|---|---|---|
| Age (years)[a] | 73.7 ± 3.92 | 41 | 73.7 ± 4.15 | 54 | 0.99 |
| Living structure[b] | | | | | |
| Alone | 33.3 | 39 | 15.1 | 53 | 0.07 |
| With spouse | 33.3 | | 32.1 | | |
| 3 persons or more | 33.3 | | 52.8 | | |
| Education[b] | | | | | |
| Elementary School | 11.4 | 35 | 6 | 50 | 0.17 |
| Junior High School | 20 | | 40 | | |
| High School | 34.3 | | 26 | | |
| Technical School | 14.3 | | 20 | | |
| University | 20 | | 8 | | |
| Work[b] | | | | | |
| Do not work | 67.5 | 40 | 45.1 | 51 | 0.23 |
| Integral period | 2.5 | | 3.9 | | |
| Part-time work | 2.5 | | 2 | | |
| Autonomous work | 2.5 | | 2 | | |
| Farm work | 12.5 | | 37.3 | | |
| Volunteer work | 7.5 | | 7.8 | | |
| Other | 5 | | 2 | | |

Values are [a]means ± SD; or [b]percentages

Table 2. Physical Performance measurements of older women living in urban and rural communities

| Variable | Urban | N | Rural | N | p |
|---|---|---|---|---|---|
| Timed Up and Go (sec)[a] | 6.44 (5.9 - 7.35) | 41 | 6.59 (6 - 7.55) | 54 | 0.44 |
| One Leg Stand (sec)[a] | 23.35 (10 - 30) | 41 | 28.31 (12.3 - 30) | 54 | 0.38 |
| Handgrip Strength (kg)[a] | 22 (19 - 26) | 40 | 25 (21.7 - 26.5) | 54 | 0.01 |
| Five Chair Standing (sec)[b] | 7.43 ± 1.75 | 41 | 8.97 ± 2.18 | 54 | <0.001 |

Values are [a]medians (interquartile); or [b]means ± SD

Table 3. Health status measurements of older women living in urban and rural communities

| Variable | Urban | N | Rural | N | p |
|---|---|---|---|---|---|
| BMI (kg/m$^2$)[a] | 21.9 ± 2.50 | 41 | 23.2 ± 3.45 | 54 | 0.04 |
| Waist Circumference(cm)[a] | 72.2 ± 5.78 | 39 | 76.7 ± 8.14 | 54 | <0.01 |
| Body Fat Percentage[a] | 29.0 ± 6.49 | 39 | 32.5 ± 6.67 | 54 | 0.01 |
| SMMI (kg/m$^2$)[b] | 8.28 (7.63 - 8.6) | 39 | 8.01 (7.67 – 8.63) | 54 | 0.91 |
| Arm muscle mass (kg/m$^2$)[b] | 1.36 (1.2 – 1.51) | 39 | 1.42 (1.33 – 1.61) | 54 | 0.06 |
| Leg muscle mass (kg/m$^2$)[b] | 4.59 (4.29 – 4.98) | 39 | 4.41 (4.1 – 4.71) | 54 | 0.08 |
| Pedometer[b] | 5791 (3992 – 7634) | 35 | 6734 (5447 – 7794) | 53 | 0.07 |
| Physical activity[c] | | | | | |
| No | 17.9 | 39 | 35.4 | 48 | 0.05 |
| Almost everyday | 20.5 | | 6.3 | | |
| 2 or 3 per week | 46.2 | | 52.1 | | |
| 1 or 2 per month | 15.4 | | 6.3 | | |
| Life-space assessment[a] | 97.0 ± 17.7 | 32 | 73.2 ± 19.9 | 53 | <0.001 |
| Geriatric Depression Scale[b] | 1 (0 – 3) | 33 | 2 (0.75 – 4) | 54 | 0.19 |
| Fear of falling[c] | 45.7 | 35 | 40.7 | 54 | 0.64 |
| Fell in past year[c] | 35.1 | 37 | 24.1 | 54 | 0.25 |
| Medical consultation[c] | | | | | |
| No | 17.5 | 40 | 18.9 | 53 | 0.36 |
| 1~2 times | 27.5 | | 20.8 | | |
| 3~4 times | 15 | | 17 | | |
| 5~6 times | 10 | | 24.5 | | |
| 7 or more | 30 | | 18.9 | | |
| Hospitalization[c] | 7.5 | 40 | 5.6 | 54 | 0.70 |
| Medications[c] | 80 | 40 | 81.5 | 54 | 0.99 |

| | | | | | |
|---|---|---|---|---|---|
| Low back pain[c] | 7.3 | 41 | 27.8 | 54 | 0.01 |
| Diabetes[c] | 4.9 | 41 | 13 | 54 | 0.18 |
| Osteoporosis[c] | 24.4 | 41 | 25.9 | 54 | 0.86 |
| Hypertension[c] | 43.9 | 41 | 38.9 | 54 | 0.62 |
| Hyperlipidemia[c] | 26.8 | 41 | 35.2 | 54 | 0.38 |
| Arthropathy[c] | 24.4 | 41 | 22.6 | 54 | 0.84 |
| Gastrointestinal problems[c] | 2.4 | 41 | 16.7 | 54 | 0.02 |

SMMI, Skeletal muscle mass index

Values are [a]means ± SD; [b]medians (interquartile); or [c]percentages